CARD CLEANING DEVICE

RELATED APPLICATIONS

This application is a continuation under 37 C.F.R. 1.53 (b)(1) of pending U.S. patent application Ser. No. 09/822,692, filed on Mar. 30, 2001, which is a continuation-in-part of U.S. patent application Ser. No. 09/483,624, filed on Jan. 13, 2000, which issued as U.S. Pat. No. 6,285,845 B1 on Sep. 4, 2001, which claims the benefit of U.S. provisional patent application Ser. No. 60/133,578, filed on May 11, 1999, having common assignee, the contents of the three prior patent applications being incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to printing, and more particularly to a card cleaning device for use in a card printer.

2. Prior Art

A conventional image forming device, such as a printer, sometimes includes a cleaning mechanism for cleaning the printable media which can be plastic, polyvinyl chloride (PVC) cards or the like before text, graphics or bar codes are applied to the media. Printable media may have one or two printable sides depending on the application. Some printable media have greater tolerance to pollution, such as dust particles, on the printable surfaces of the printable media and are still receptive to the printer for printing images thereon even though the printable surfaces of the printable media might not be very clean. Printers may use a ribbon mechanism for transferring images to the paper surface or an injection mechanism for depositing carbon particles on the paper surface to form images. The carbon particles ordinarily are well defined during printing and do not disperse once deposited on the surface of the paper. Thus, a light deposition of dust particles does not degrade significantly the printed image on the paper surface.

Other types of printable media, such as PVC cards, are particularly susceptible to pollution, i.e. the printable surface (s) of the PVC card must be maintained clean before printing to achieve acceptable print quality. Normally, these printable media, e.g., the PVC cards, require a high temperature thermal printing process to form images. Ordinarily, the temperature of the thermal printing process used to form images on these plastic printable media is very high, often much higher than a temperature of the thermal printing process, if any, needed to print on regular paper. As a result, if the printable surfaces of these printable media, e.g., the plastic cards, are not clean, the images printed thereon tend to be blurred due to this high temperature process. Even a slight deposition of dust particles on the printable surface of the plastic card will likely blur the images to be formed and greatly affect the quality of the printing results. Thus, having a cleaning mechanism is necessary for the printer adapted to print PVC cards.

The cleaning mechanism in a conventional printer typically is located inside the printer and is adjacent to a feeding mechanism. The feeding mechanism of the printer is accessible from outside for loading or unloading a printable medium stack onto the feeding mechanism. During operation, the feeding mechanism feeds the printable media, such as cards, into the printer to be printed by a print head of the printer. The cleaning mechanism of the conventional printer is coupled to the conventional printer between the feeding mechanism and the print head. Therefore, the cleaning mechanism may clean the printable medium, such as a card, fed into the printer before the card is printed by the print head.

The conventional cleaning mechanism typically includes a cleaning roller and a drive roller rotatably coupled to a support frame securely mounted to the conventional printer. The cleaning roller and the drive roller are approximately positioned in parallel to each other. The drive roller normally is rotatably coupled to the support frame and cannot be moved either laterally or vertically. The cleaning roller, however, is often rotatably coupled to the support frame by coupling both ends of a cleaning roller shaft of the cleaning roller to the support frame. The cleaning roller is properly located so that it can be positioned directly above the drive roller and is adapted to press the printable medium against the drive roller. Moreover, positions of the drive roller and the cleaning roller inside the printer are precisely disposed to allow the printable media traveling there between. A drive roller shaft of the drive roller is coupled to a gear system of the conventional printer for rotation, and the gear system is further coupled to a motor of the printer, where the motor is adapted to control the rotation of the drive roller.

When the printable medium, such as a card, is fed into the printer by the feeding medium, the card will urge the movable cleaning roller slightly up by approximately the thickness of the card. Due to the compression effect, the cleaning roller will press the card against the drive roller located underneath. The cleaning roller is typically made by silicone materials molded to the roller shape for encircling the cleaning roller shaft. In addition, a treatment process is applied to the cleaning roller for making the silicone surface of the cleaning roller sticky. The above-mentioned treatment process is well known to persons skilled in the art and is not an aspect of the present invention. Most commercially available printers incorporating the cleaning devices have the drive rollers made of the same materials as are commonly used for making the platens of the printers. When the drive roller is rotated by the motor, it drives the card toward the print head. As mentioned, the cleaning roller presses the card against the drive roller, so when the card is driven through by the drive roller, the card will cause the cleaning roller to rotate due to the sticky effect of the silicone surface of the cleaning roller.

Moreover, the sticky surface of the cleaning roller serves the purpose of removing undesirable pollutants, such as dust particles, deposited on the printable surface of the card. When the card moves through between the cleaning roller and the drive roller, the cleaning roller would pick up dust particles deposited on the surface of the card facing the cleaning roller due to the sticky effect of the cleaning roller. Thus, the printable surface of the card should face the cleaning roller for cleaning. Alternatively, drive rollers of some conventional printers are made of sticky silicone materials similar to the cleaning roller. As a result, the drive roller and the cleaning roller of these printers are adapted to clean opposite surfaces of the card. The printable surface of the card may therefore face either up or down for cleaning, or both sides of the card could be printable surfaces.

The sticky surface of the cleaning roller removes dust particles from the card surface by sticking the dust particles out of the printable surface of the card as the card rolls through the cleaning roller. After being removed from the card, the dust particles will stick to the surface of the cleaning roller. As a result, the surface of the cleaning roller accumulates more dust particles each time the cleaning roller cleans a card, and the efficacy of the cleaning roller is

accordingly reduced after each cleaning. At some point in time, the cleaning roller will no longer be able to effectively remove any more dust particles from the cards due to the dirtiness on its surface. The cleaning roller, therefore, needs to be clean, or even be replaced, periodically to maintain the effectiveness of the cleaning device of the conventional printer.

As stated, the cleaning roller is coupled to the printer by inserting its cleaning roller shaft into a pair of slots on the support frame of the printer. Generally, the slots are located deep inside the printer, so it is quite difficult and inconvenient to install, to replace, or to remove the cleaning roller for cleaning or for maintenance purposes. Since the drive roller is positioned underneath the cleaning roller in the printer, it is even harder to remove or to replace those drive rollers that also serve the function to clean the cards and therefore need to be cleaned periodically. Moreover, the size of the cleaning roller in a typical conventional printer is quite small. Usually, the cleaning roller has a width of approximately 2.4 inches—slightly wider than the width of a regular business card, and it has a diameter of approximately 0.6 inches. Thus, the cylindrical surface of the cleaning roller gets saturated by the dust particles quite easily because the surface of the cleaning roller is quite small, and the cleaning roller needs to be cleaned frequently. Thus, the need arises for a card cleaning device (or cartridge) that provides easy access for maintenance, occupies a relatively small space inside the printer and eliminates the need for frequent maintenance of the cleaning rollers.

SUMMARY OF THE INVENTION

The present invention is directed to a card cleaning device for use in an image forming machine, comprising a housing adapted to be removably coupled to the image forming machine; a first cleaning member removably coupled to the housing and adapted to clean a card being fed at an angle relative to the housing, the housing being adapted to receive the card at an angle; and a second cleaning member removably coupled to the housing and adapted to clean the first cleaning member during machine operation.

The present invention is also directed to a card cleaning system for use with an image forming machine, comprising a housing adapted to be removably coupled to the image forming machine; a first cleaning member removably coupled to the housing and adapted to clean a card being fed at an angle relative to the housing along a card entry path, the housing being adapted to receive the card at an angle, the angle substantially defined between the card entry path and a card exit path relative to the housing; means for feeding the card at an angle relative to the housing; and a second cleaning member removably coupled to the housing and adapted to clean the first cleaning member during machine operation.

These and other aspects of the present invention will become apparent from a review of the accompanying drawings and the following detailed description of the preferred embodiments of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a partial perspective view of a printer including a card cleaning cartridge in accordance with the present invention;

FIG. **2** is a front perspective view of the card cleaning cartridge shown in FIG. **1**;

FIG. **3** is a perspective view of the card cleaning cartridge of FIG. **2** with the upper cleaning roller removed;

FIG. **4** is a bottom perspective view of the card cleaning cartridge of FIG. **2** in accordance with the present invention;

FIG. **5** is a partial perspective view of the printer of FIG. **1** with the card cleaning cartridge removed;

FIG. **6** is a partial perspective view of the printer of FIG. **1** with the card cleaning cartridge being installed in the printer in accordance with the present invention;

FIG. **7** is a cross-sectional view of the printer and card cleaning cartridge of FIG. **1** in an operational configuration;

FIG. **8** is a perspective view of a preferred configuration of a card cleaning device with the lid in an open position in accordance with the present invention;

FIG. **9** is a perspective view of the card cleaning device of FIG. **8** with the lid in a closed position in accordance with the present invention;

FIG. **10** is an exploded perspective view of the various components of the card cleaning device of FIG. **8**;

FIG. **11** is a perspective view of a user performing maintenance on the card cleaning device of FIG. **8**;

FIG. **12** is a perspective view of a card about to be fed at an angle into the card cleaning device of FIG. **8** in accordance with the present invention;

FIG. **13** is a perspective view of a card being fed into the card cleaning device of FIG. **8** in accordance with the present invention;

FIG. **14** is a perspective view of a printed card exiting the card cleaning device of FIG. **8** in accordance with the present invention;

FIG. **15** is a cross-sectional view taken along section line **15**—**15** of FIG. **14** in accordance with the present invention;

FIG. **16** is a schematic view of a card about to be fed at an angle from a feeder into the card cleaning device of FIG. **8** in accordance with the present invention;

FIG. **17** is a schematic view of a card being fed from a feeder into the card cleaning device of FIG. **8** in accordance with the present invention;

FIG. **18** is a schematic view of a printed card exiting the card cleaning device of FIG. **8** and about to pass under a feeder in accordance with the present invention;

FIG. **19** is a partial perspective view of the card cleaning device of FIG. **8** installed in a printer in accordance with the present invention;

FIG. **20** is a perspective view of a card cleaning device of an alternative design in accordance with the present invention;

FIG. **21** is an exploded perspective view of the various components of the card cleaning device of FIG. **20**;

FIG. **22** is a perspective view of a user performing maintenance on the card cleaning device of FIG. **20** in accordance with the present invention;

FIG. **23***a* is a perspective view of a card about to be fed at an angle into the card cleaning device of FIG. **20** in accordance with the present invention;

FIG. **23***b* is a schematic view of a card about to be fed at an angle from a feeder into the card cleaning device of FIG. **20** in accordance with the present invention;

FIG. **24***a* is a perspective view of a card being fed into the card cleaning device of FIG. **20** in accordance with the present invention;

FIG. **24***b* is a schematic view of a card being fed from a feeder into the card cleaning device of FIG. **20** in accordance with the present invention;

FIG. **25***a* is a perspective view of a printed card exiting the card cleaning device of FIG. **20** in accordance with the present invention;

FIG. 25*b* is a schematic view of a printed card exiting the card cleaning device of FIG. **20** and about to pass under a feeder in accordance with the present invention; and

FIG. **26** is a cross-sectional view taken along section line **26**—**26** of FIG. **25***a* in accordance with the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Hereinafter, some preferred embodiments of the present invention will be described in detail with reference to the related drawings of FIGS. **1**–**26**. Additional embodiments, features and/or advantages of the invention will become apparent from the ensuing description or may be learned by the practice of the invention.

In the figures, the drawings are not to scale and reference numerals indicate the various features of the invention, like numerals referring to like features throughout both the drawings and the description.

The following description includes the best mode presently contemplated for carrying out the invention. This description is not to be taken in a limiting sense, but is made merely for the purpose of describing the general principles of the invention.

In FIG. **1**, a card cleaning cartridge **10** according to the present invention is incorporated into a printer **1** between a feeding mechanism (not shown) and a print head (not shown) of printer **1**. The feeding mechanism has a receptacle means (not shown) adapted to store a stack of printable media, such as plastic cards, to be fed into printer **1** by feeding mechanism **2**. Feeding mechanism **2** sequentially moves the cards into a body **8** of printer **1** to avoid jamming printer **1** during printing.

Inside body **8** of printer **1**, a drive roller **30** (FIG. **7**) is positioned adjacent to feeding mechanism **2** for receiving the cards fed into body **8** by feeding mechanism **2**. A drive roller **30** has a drive roller shaft (not shown) rotatably coupled to a pair of receptive holes such as a hole **72***a* (FIGS. **1**, **5**, **6**) disposed at each end of a support frame (not shown) of printer **1**. The mounting position of drive roller **30** within printer **1** is predetermined and generally cannot be changed. Thus, drive roller **30** basically cannot move horizontally or vertically with respect to body **8** of printer **1**, although it is rotatable to drive the cards toward the print head.

A gear system (not shown) positioned inside body **8** of printer **1** is coupled to the drive roller shaft at one end for rotating drive roller **30**. The gear system is further coupled to a motor (not shown), also positioned inside printer body **8** of printer **1**. The motor is adapted to rotate the drive roller **30** through the connection of the gear system.

Referring to FIG. **1**, the cartridge **10** is positioned inside the printer **1** adjacent to the feeding mechanism and is directly over the drive roller **30**. The cartridge **10** has a lower cleaning roller **16** movably coupled to a cartridge frame **12** at opposite ends, as shown in FIG. **2**. The lower cleaning roller **16** comprises a lower roller body **20** and a lower roller shaft **22** wherein the lower roller body **20** securely encircles the lower roller shaft **22**. A pair of generally elliptically-shaped slots **36***a*, **36***b* are respectively positioned on left and right side walls **32***a*, **32***b* of the cartridge frame **12** near a bottom end. Opposite ends of the lower roller shaft **22** are respectively inserted into the elliptically-shaped slots **36***a*, **36***b* which are adapted to allow the ends of the lower roller shaft **22** to slide vertically along the long axes of the elliptically-shaped slots **36***a*, **36***b*. The short axes of the elliptically-shaped slots **36***a*, **36***b* are slightly larger than diameters of the ends of the lower roller shaft **22**—just enough to accommodate the ends therein, so that the lower roller shaft **22** may not move horizontally within the elliptically-shaped slots **36***a*, **36***b*, as shown in FIG. **2**. As a result, the lower cleaning roller **16** may only move vertically with respect to the cartridge frame **12**.

Drive roller **30** is made of conventional platen materials. Thus, the surface of the drive roller **30** is usually not sticky, and driving a card situated over the drive roller **30** requires a pressure from above the card surface pressing the card against the drive roller **30**. The pressure comes from the lower cleaning roller **16** of the cartridge **10**. When the cartridge **10** is mounted inside printer **1**, the lower cleaning roller **16** is positioned generally parallel to and directly above the drive roller **30**. The lower cleaning roller **16** is located near the bottom of the cartridge **10**, so that when the cartridge **10** is properly mounted on the printer **1**, the lower cleaning roller **16** would, due to its weight and the pressure from a upper cleaning roller **14**, press against the drive roller **30**. As a result, the cards will be driven between the drive roller **30** and the lower cleaning roller **16** as the cards are sequentially fed by the feeding mechanism.

As stated, the lower cleaning roller **16** is vertically movable within the cartridge **10** while the drive roller **30** is immovably, albeit rotatably, coupled to the printer **1** but cannot readjust its vertical position within the printer **1**. When a card is fed between the lower cleaning roller **16** and the drive roller **30**, the card will upwardly displace the lower cleaning roller **16** by the thickness of the card, while the frame **12** of the cartridge **10** is coupled to the printer **1** by a pair of magnets **68***a*, **68***b* (FIG. **4**) and does not move upward. In addition, the length of the long axes of the elliptically-shaped slots **36***a*, **36***b* is selected to accommodate the thickest cards possibly intended to be fed into the printer **1** for printing. Thus, the upper most position that the lower cleaning roller **16** might reach is determined by the length of each of the long axes of the elliptically shaped slots (e.g., slot **36***b* in FIG. **2**).

As a blank card is fed between the lower cleaning roller **16** and drive roller **30**, the card is driven by the drive roller **30**, which comes into contact with a bottom surface of the card, toward the print head. The lower cleaning roller **16** is adapted to remove dust from the surface of the card coming into contact with the lower cleaning roller **16**. Unlike the drive roller **30**, no gearing system is coupled to the lower cleaning roller **16** to drive it. Moreover, the roller body **20** of the lower cleaning roller **16** is commonly made of **35** Shore-A silicone materials, the surface of which, after processed, will be slightly sticky. A manufacturing procedure to mold the silicone materials into a sticky roller is well known in the art and is not a concern of the present invention. Due to the sticky surface of the lower roller body **20**, when the card is driven toward the print head by the drive roller **30** between the lower cleaning roller **16** and the drive roller **30**, the card will cause the lower cleaning roller **16** to rotate over the full length of the printable surface, which faces the lower cleaning roller **16**. As a result, the sticky surface of the lower roller body **20** will pick up dust particles deposited on the printable surface of the card while the card is moved over it. The sticking power of this lower cleaning roller **16**, however, shall not be too high. Otherwise, the lower roller body **20** will not only pick up the dust particles off the card surface but will also stick to the card itself causing the card to jam the printer **1**. The **35** Shore-A silicone materials commonly used to make the lower roller body **20** provide an ideal sticky surface, i.e.,

sticky enough to pick up most dust particles on the printable surface but not too sticky so as not to jam the printer **1**.

The lower roller body **20** has a low hardness in order not to damage the printable surfaces of the cards. As mentioned, the lower roller body **20** will attach some dust to its surface during cleaning. Thus, if the surface of the lower roller body **20** is too hard, it will probably cause damages, such as scratches, to the printable surface of the card when it rolls over the card. Moreover, the low hardness of the lower roller body **20** allows a small distortion of its surface when under pressure. Hence, it provides a good contact between the lower cleaning roller **16** and the card because a contact surface between them increases when the hardness of the lower roller body **20** decreases and the contact surface is always on the whole card width, even if there are dust particles on the card, due to the slight distortion of the surface of the lower roller body **20**. Again, a lower roller body **20** made preferably by commonly used silicon materials would provide an ideal surface hardness. In other alternative embodiments, other materials may also be adopted to make the lower roller body **20** as long as the stickiness and the hardness qualities of the final product will fit the above-mentioned principles according to the present invention.

Each time the lower cleaning roller **16** rolls over a card to clean its printable surface, the surface of the lower roller body **20** gets dirtier accordingly. Consequently, as soon as this lower cleaning roller **16** gets some dust on its surface, its cleaning power decreases. A method to keep the surface of the lower roller body **20** clean is therefore needed. As stated previously, the cleaning roller in a conventional printer needs to be removed frequently in order to clean the surface of the cleaning roller or to replace a new one. Removing and cleaning a cleaning roller from the conventional printer is not convenient and may be quite labor intensive. Furthermore, the cleaning roller gets dirty frequently, and replacing a new one each time it gets dirty is not very cost effective. All these problems are resolved by the present invention, as will be explained in further detailed.

In accordance with a preferred embodiment of the present invention, an additional upper cleaning roller **14** is included in cartridge **10**. Referring to FIG. **3**, the upper cleaning roller **14** comprises an upper roller body **18** capped by an end cap at each end, **28***a* or **28***b*. The end caps **28***a*, **28***b* each includes cap nobs **26***a*, **26***b* respectively coupled to a support rack **24***a* or **24***b* through narrow nob necks. The upper cleaning roller **14** is rotatably coupled to the side walls **32***a*, **32***b*, and is positioned directly above the lower cleaning roller **16**. A pair of open slots **38***a*, **38***b* having approximately reverse-J shape are respectively formed in the side walls **32***a*, **32***b*. The narrow nob necks of the cap nobs **26***a*, **26***b* are adapted to slide into and be received by the open slots **38***a*, **38***b*. The cap nobs **26***a*, **26***b* are much larger than their respective nob necks. As a result, the upper cleaning roller **14** will not unintendedly fall off the cartridge **10** once it is mounted thereon, as shown in FIG. **2**. The vertical length of the open slots **38***a*, **38***b* are also selected so that when the upper cleaning roller **14** is inserted into the open slots **38***a*, **38***b* of the cartridge **10**, the upper roller body **18** is adapted to touch and press against the lower roller body **20**. In addition, the diameters of the nob necks of the cap nobs **26***a*, **26***b* are smaller than the channel widths of the open slots **38***a*, **38***b*. Therefore, the nob necks may freely rotate and slide vertically within the open slots **38***a*, **38***b*, and the upper cleaning roller **14** will accordingly rotate and slide vertically.

Left and right leaf springs **34***a*, **34***b* are mounted to the inner side of the side walls **32***a*, **32***b*, as shown in FIGS. **2** and **3**. The leaf springs **34***a*, **34***b* have extensions adapted to press down on the nob necks to in tern press the upper cleaning roller **14** downward against the lower cleaning roller **16**. Thus, the upper cleaning roller **14** is adapted to be rotated by friction with the lower cleaning roller **16** when the latter rotates. In one embodiment, the left and right leaf springs have approximately 0.1 kg pressing force on the upper cleaning roller **14**.

The upper roller body **18** comprises a tube shape roller and a sticky strip is wrapped over the tube shape roller. The sticky strip has a higher sticking power than the surface of the lower cleaning roller **16** and is thus adapted to remove dust deposited on the surface of the lower cleaning roller **16**. As a result, the upper cleaning roller **14** removes directly from the lower cleaning roller **16** and indirectly from the cards. The sticky power of the surface of the upper roller body **18** is stronger than the sticky power of the surface of the lower roller body **20**. Due to the high sticking power of the upper cleaning roller **14**, the cleaning of the lower cleaning roller **16**, and consequently the cleaning of the cards, is far more efficient than when using a duster or a cleaning card. Also, sticking power of the upper roller body **18** can be stronger than that of the lower roller body **20** since the upper roller body **18** does not touch the cards directly. Thus, the higher sticking power of the upper roller body **18** will not hold onto the cards and jam the printer **1**. Thus, the lower cleaning roller **16** serves as an intermediate to transfer dust from the cards to the upper cleaning roller **14**. Accordingly, the lower cleaning roller **16** does not need cleaning maintenance and its life is potentially much longer than those counterparts used in the conventional printers.

The upper cleaning roller **14** is also larger than the lower cleaning roller diametrically, so the upper cleaning roller **14** has a larger effective cleaning surface than the surface of the lower cleaning roller **16**. In one embodiment where the upper cleaning roller **14** and the lower cleaning roller **16** have a same width-W, and the upper cleaning roller **14** has a radius R1 and the lower cleaning roller **16** has a radius R2, the effective cleaning surface of the upper cleaning roller **14** will be $2\pi WR1$ and the lower cleaning roller **16** will be $2\pi WR2$. The effective cleaning surface difference between the upper cleaning roller **14** and the lower cleaning roller **16** will be $2\pi W(R1-R2)$. In this embodiment, W is approximately 2.4 inches, R1 is approximately 0.5 inches, and R2 is approximately 0.3 inches. Thus, the effective cleaning surface of the upper cleaning roller **14** is much larger than the effective cleaning surface of the lower cleaning roller **16**. As a result, the upper cleaning roller **14** can retain much more dust than the lower cleaning roller **16** and need not be cleaned as frequently as the smaller surface of the cleaning roller used in the conventional printer.

The upper cleaning roller **14** is also vertically movable when mounted on the cartridge **10**. When the card upwardly displaces the lower cleaning roller **16**, as stated above, the upper cleaning roller **14** is also upwardly displaced accordingly. Thus, the upper cleaning roller **14** cleans the lower cleaning roller **16** when the latter cleans the printable surface of the card. In addition, the sticky strip of the upper roller body **18** is made of double-coated paper tape. Thus, the sticky strip and/or the whole upper roller body **18** are easily replaceable. In one embodiment, the paper tape is approximately 12 mil thick having an adhesion force of 40 oz/inch and a tensile strength of 34 lb/inch. The upper roller body **18** is made of materials much cheaper than the silicone materials used to make the lower roller body **20**. As compared to the conventional printers that replace the silicone cleaning rollers for maintenance, the present invention replaces the

upper roller body **18** of the upper cleaning roller **14** or the sticky strip. By making the upper roller body **18** and/or the sticky strip replaceable, which is much cheaper than replacing the lower cleaning roller **16**, the present invention is much more cost effective than the conventional printers.

Unlike the conventional printers, the present invention also has the advantage of easy access to and easy replacement of the cleaning cartridge. As can be seen from FIGS. **2** and **4**, the cartridge **10** has a latch **46** at one end and a handle **40** at the opposite end, both on the top of the cartridge **10**. The latch **46** is adapted to be inserted into a latch slot **50** located on a back wall **53** inside the printer **1**, as shown in FIG. **5**. The latch slot **50** is of the size slightly wider than the latch **46**, so the latch **46** can be inserted therein but the latch slot **50** leaves not much extra space for the latch **46** to slide laterally or vertically. When the latch **46** is inserted into the latch slot **50**, the latch **46** latches the cartridge **10** to the printer **1** by catching against the reverse side of the back wall **53**. Furthermore, the cartridge **10** has the pair of magnets **68***a*, **68***b* positioned on the left side wall **32***a* at the outer side near the bottom (FIG. **4**). The magnets **68***a*, **68***b* are held by a holder **66** securely mounted on the left side wall **32***a* at the outer side. When the cartridge **10** is mounted on the printer **1**, the magnets **68***a*, **68***b* will be firmly held by strong magnetic forces to a metal plate **52**, which is positioned inside the printer **1** under the slot **50**. Thus, the cartridge **10** is securely mounted inside the printer **1** without undesired lateral movement during operation, as shown in FIG. **1**. In one embodiment, the magnetic force of each magnet is approximately 0.3 Kg at 0.5 mm, and the magnets are made of compressed Plasto-Neodymium materials. In alternative embodiments, other magnets made of different materials and/or providing different magnetic forces may be adopted without deviating from the noted inventive principle.

Thus, the cartridge **10** is much easier to remove than removing the cleaning rollers in the conventional printers. To remove the cartridge **10**, the user just pulls the handle **40** upward to disengage the magnets **68***a*, **68***b* from the metal plate **52**, as shown in FIG. **6**. Once the magnets **68***a*, **68***b* and the metal plate **52** are disengaged, the user may lift the cartridge **10** up until the cartridge **10** is displaced in an angle suitable for the latch **46** to slide out of the latch slot **50** (FIG. **5**). To install the cartridge **10** onto the printer **1**, a reverse process to the above-mentioned procedure is performed. Unlike the present invention, to remove a cleaning roller in a conventional printer the user needs to disengage the cleaning roller from two slots buried deep inside the conventional printer. Thus, the present invention improves the accessibility and the ease of replacement of the cleaning cartridge greatly.

As mentioned, the upper cleaning roller **14** is made of inexpensive materials and can be manually removed from cartridge **10**. The upper cleaning roller **14** has an end cap **28***a* or **28***b* (molded plastic) attached at each end, which allows the user to handle it without putting fingers on the sticky surface of the upper roller body **18**. Any new upper cleaning roller **14** is delivered with a removable coating protecting the sticky surface from dust during transportation and from contacting with a shipping package. An optional configuration is to have a multi-sticking-coating upper cleaning roller **14**. Thus, a dirty coating, which will usually be the outermost one, could be peeled off, causing a new sticking coating to appear from underneath.

From the foregoing, it will be appreciated that, although specific embodiments of the invention have been described herein for purposes of illustration, various modifications may be made by persons skilled in the art without deviating from the spirit and/or scope of the invention. In particular, dimensions of all components may be varied for adapting to different-size image forming machines. The drive roller may also be made of silicon materials, making the drive roller suitable to clean the bottom surfaces of the cards. The leaf springs of the above-described preferred embodiment may be replaced by alternative types of mechanisms to provide pressure to the upper and lower cleaning rollers.

In accordance with another preferred embodiment of the present invention and as generally illustrated in FIGS. **8–19**, a card cleaning device for use in card printers, generally referred to by reference numeral **100**, comprises a plastic frame **102** (FIG. **10**) having a lower portion **101** adapted to operatively accommodate a bottom card cleaning roller **106** and an upper portion **121** adapted to operatively accommodate a top adhesive roller **104** on top of card cleaning roller **106** with top roller **104** being in frictional contact with roller **106**. Card cleaning device **100** also includes a plastic lid **108** pivotally hinged on each side to upper portion **121** of plastic frame **102** for manual rotation between a closed position during printer operation and an open position to allow easy access to top adhesive roller **104** for maintenance or replacement as generally illustrated in FIG. **11**.

Plastic lid **108** includes at each end an integral cylindrical post, such as post **155** in FIG. **10** or post **156** in FIG. **12**, for mounting into a respective aperture, such as aperture **158** or aperture **157** provided on upper portion **121** of frame **102** (FIGS. **10**, **12**), respectively. Lid **108** can be manually rotated by the user to a fully open position to facilitate roller maintenance as shown by directional arrow **162** in FIG. **11**. A pivot axis **154** may be defined through the center of each cylindrical post (**155**, **156**) as illustrated in FIG. **12** with lid **108** pivoting about axis **154**. The approximate range of angular motion of lid **108** about pivot axis **154** may be, for example, about 0°–90° with 0° corresponding to a fully closed position of lid **108** as shown, for example, in FIG. **9**, and 90° corresponding to a fully open position of lid **108** as shown, for example, in FIGS. **8**, **11**. Other ranges of motion for lid **108** may be utilized provided such other ranges of motion do not depart from the scope and spirit of the present invention.

Bottom card cleaning roller **106** is essentially identical in construction to lower cleaning roller **16** of FIG. **2** and includes a solid annular silicon rubber body **107** (FIG. **10**) with a slightly sticky outer surface area for picking up dust particles from a passing card and a solid generally cylindrical shaft **110** disposed inside annular body **107** and projecting to a certain extent on each side (away from body **107**) as shown in FIG. **10**. Bottom card cleaning roller **106** performs essentially the same function as lower cleaning roller **16** of FIG. **2** during device operation. Cylindrical shaft **110** mounts at each end for rotation in a generally L-shaped aperture provided on each side of frame **102** such as aperture **112** (FIG. **10**) and aperture **114** (FIG. **14**). Apertures **112**, **114** are designed to allow some vertical movement of mounted shaft **110** to accommodate the card thickness of a passing card but almost no horizontal movement of mounted shaft **110** (FIG. **14**) during printer operation. Each aperture is also adapted to allow easy removal of bottom roller **106** for maintenance as generally illustrated in FIG. **10**. Specifically, each L-shaped aperture has a generally elongated vertical bottom portion, such as bottom portion **111** of aperture **112** (FIG. **10**), for accommodating the projecting end of mounted shaft **110** and an elongated generally outwardly curved (away from lower portion **101** of frame **102**) horizontal top portion, such as top portion **113** of aperture **112** (FIG. **10**), to provide the extra space needed to allow disengagement of

each end of mounted shaft **110** from frame **102** whenever bottom cleaning roller **106** needs maintenance or replacement. Before bottom roller **106** can be disengaged from frame **102**, top adhesive roller **104** should be removed from frame **102** as generally illustrated in FIG. **11**.

As further depicted in FIG. **10**, top adhesive roller **104**, which has similar construction and essentially identical function as upper cleaning roller **14** of FIG. **3**, comprises generally a tubular plastic body **122** with an inner removable two-piece ribbed core **124** which terminates on each side with a circular end cap such as end caps **126, 128** (FIG. **10**). The ribbed core construction is presently preferred as less material is used to construct the core during manufacturing which reduces weight and cost for the manufacturer and in addition the ribs provide better resistance to traction and better adherence compared to a planar (cylindrical) core surface. Each end cap includes an outwardly protruding cylindrical post, such as posts **130, 132** (FIG. **10**), which is supported on four integral generally triangular-shaped racks such as racks **136, 138, 140, 142** (FIG. **10**). Each cylindrical post mounts for rotation in a corresponding generally V-shaped slot on frame **102** (flared portion of slot facing away from upper portion **121** of frame **102**), such as slot **135** or slot **137**, provided at each end of frame **102** as shown in FIG. **11**. Slots **135, 137** are designed to allow some vertical movement but almost no horizontal movement of a mounted post (of top adhesive roller **104**). The end cap design facilitates insertion of top adhesive roller **104** in slots **135, 137** while the V-shaped slot design helps keep mounted top roller **104** in place during device operation. Top roller **104** is preferably mounted directly on top of mounted bottom roller **106** in accordance with the general principles of the present invention as shown in FIG. **15**.

The outer surface of tubular body **122** is preferably wrapped with an adhesive strip layer **103** (FIG. **8**) which is essentially identical to the one used in the above-described preferred embodiment and is generally stickier than the outer surface of bottom cleaning roller **106**. Several overlapping adhesive strip layers (not shown) may be used if desired such that the top-most used adhesive layer may be peeled off by the user to reveal another clean (unused) adhesive layer underneath. Furthermore, adhesive top roller **104**, preferably, has a diameter greater than the diameter of bottom card cleaning roller **106** (FIG. **15**) so as to provide a substantially larger effective cleaning surface area relative to the surface area of bottom cleaning card roller **106**. The larger effective cleaning surface area allows top adhesive roller **104** to pick up and retain more dust particles than bottom roller **106** which prolongs the life of bottom cleaning roller **106** and is a significant advantage over prior art card cleaning schemes as bottom roller **106** need not be changed as often as needed in conventional card printers.

Maintenance of top adhesive roller **104** is relatively easy as roller **104** may either be replaced with a new adhesive roller or, if equipped with multiple surface adhesive layers, the user would simply peel off the top used adhesive layer to expose a clean adhesive layer underneath. To perform maintenance on top adhesive roller **104**, the user flips lid **108** to one side with one hand as shown by directional arrow **162** and pulls top roller **104** out with the other hand (FIG. **11**).

To maintain pressure on cylindrical posts **130, 132** of top adhesive roller **104** during device operation, lid **108** is preferably provided on each side with an integral generally rectangular-shaped bump, such as bumps **159, 161** (FIGS. **8, 10, 11**) and is spring loaded via a pair of coiled springs **163, 165** (FIG. **10**) which are mounted between lid **108** and the body of plastic frame **102** as generally illustrated in FIGS. **11–14**. For example, upper end **167** of coiled spring **165** is preferably mounted into a corresponding aperture **169** provided on the inner side of frame **102** and lower end **171** of coiled spring **165** is mounted into a corresponding aperture **173** provided on the body of frame **102** as shown in FIG. **12**. Spring **163** is mounted on the other side in a similar fashion (FIG. **12**). When lid **108** is in a fully closed position during device operation coiled springs **163, 165** exert the necessary amount of pressure on posts **130, 132** of top adhesive roller **104** through the body of lid **108** to assure proper operation of top adhesive roller **104**. Spring loading of lid **108** maintains (by way of top adhesive roller **104**) bottom roller **106** in sufficient frictional contact with the top surface of a card being fed for pre-printing cleaning from a feeder to allow passage of a card such as card **116** between a rotating first driver roller **118** and cleaning roller **106** (which rotates by friction) when lid **108** is in a fully closed position during device operation as depicted, for example, in FIG. **15**. First drive roller **118** is driven by a motor (not shown) which is mounted in the body of the printer (not shown). Shaft **120** of first driver roller **118** is preferably disposed directly under shaft **110** of bottom card cleaning roller **106** as depicted in FIG. **15** in accordance with the general principles of the present invention to ensure proper operation of card cleaning device **100**. Rotating shaft **120** indirectly drives (rotates) bottom cleaning roller **106** which frictionally drives (rotates) top adhesive roller **104** under fully closed lid **108** during device operation enabling continuous cleaning of bottom cleaning roller **106** by top adhesive roller **104**. Lower portion **101** of frame **102** is preferably provided at each end with a concave circular notch, such as notches **105, 109** (FIG. **10**), which is designed to fit around each end of rotating driver roller shaft **120** (not shown) when card cleaning device **100** is installed for operation in an appropriately configured card printer.

Card cleaning device **100** is preferably removably installed in a card printer via a pair of integral, elongated flexible plastic arms **170, 172** disposed on opposite sides of card cleaning device **100** as depicted, for example, in FIG. **8**. Each elongated flexible arm (**170, 172**) is provided on the outside with an integral outwardly projecting horizontal bar, such as bar **174** on arm **170** and bar **176** on arm **172** (FIG. **8**). Each arm is configured to slide removably into a corresponding receptacle, such as receptacle **178** (FIG. **19**) provided on the inner wall **180** of a printer frame **182** until bar **174** (or bar **176**) snaps inside the receptacle with the outer portion of each arm sticking out (above each receptacle) as illustrated in FIG. **19**.

In accordance with one aspect of the present invention, the front side **131** (FIG. **8**) or back side **133** (FIG. **12**) of card cleaning device **100** may be used for card feeding, i.e., card cleaning device **100** may be installed for operation in printer frame **182** on either side which is an advantage over prior art cleaning cartridges which need to be inserted in a printer only on one side. Card feeding is accomplished via one of two generally rectangular-shaped card feeding slots provided on opposite sides of lower portion **101** of card cleaning device **100**, e.g., front feeding slot **184** (FIG. **8**) or back feeding slot **186** (FIG. **12**) whereby each one of the feeding slots may be used for card feeding depending on the particular orientation of the installed card cleaning device **100**.

For example, if back feeding slot **186** is used for feeding as shown in FIGS. **12, 13**, the card (e.g., card **117**) would enter back feeding slot **186** at an angle (FIG. **16**) as shown by directional arrow **188** in FIG. **12**, bend slightly at its entering end (FIG. **17**) as shown by directional arrow **189** in

FIG. 13, then pass horizontally for (pre-printing) cleaning between first driver roller 118 and bottom cleaning roller 106, exit card cleaning device 100 via front slot 184 for printing, return to (i.e., re-enter) card cleaning device 100 after printing via front feeding slot 184 and exit card cleaning device 100 (FIG. 18) again (on the same side it originally entered) via back slot 186 as shown by directional arrow 187 in FIG. 14 on its way out to a card output hopper (not shown).

Each card is preferably fed from a card feeder 190 at an angle to save space inside printer frame 182 which allows for the manufacture of a more compact printer which is an advantage over conventional bulky card printers. Card feeder 190 is preferably disposed over the card exit path defined by a horizontal plane X passing centrally between bottom cleaning roller 106 and first driver roller 118 (FIG. 18) as near as possible to card cleaning device 100. The preferred angle of entry is approximately 15° which is measured between horizontal plane X and an entry card path Z of an entering card such as card 117 with entry path Z being respectively at an angle of 75 degrees to a vertical plane Y passing through the outer wall of frame 102 of card cleaning device 100 as generally shown in FIG. 16. Other angles of entry may be utilized depending on the particular printer configuration as long as such angles of entry do not deviate from the intended purpose of the present invention.

Card feeder 190 includes a spring loaded plate 191 which exerts pressure on a staircase-like stack of blank cards 192 with the card exit path defined between a rotating second drive roller 194 and the front end 193 of spring loaded plate 191 as shown in FIG. 16. Plate 191 is spring loaded via a series of coiled springs 195 (FIG. 16) with blank cards being fed to card cleaning device 100 one at a time. A card exit slot 198 is defined between a flexible silicon rubber guide 196 attached to the front of card feeder 190 and the bottom portion 197 of card feeder 190 which allows the passage of only one card at a time as illustrated in FIG. 16. Flexible guide 196 is is adapted to handle any card thickness due to its flexibility and is preferably attached to the front of card feeder 190 by a series of plastic pins (e.g. pin 197—FIG. 16) provided on the front of card feeder 190 which are threaded in corresponding apertures (not shown) provided on rubber guide 196 and then heated and flattened to join the two parts together. In one example, the distance between roller 118 and roller 194 is ¾ of an ISO card (ISO card dimension −87.72±0.25 mm).

Bending of card 117 is achieved naturally by means of flexible guide 196, which pushes on card 117 preventing the card from lifting up on its own, the translation provided by second drive roller 194, and an integral elongated plastic guide plate provided proximate to the bottom portion of each card feeding slot of card cleaning device 100 under bottom cleaning roller 106 (e.g., guide plate 141 in FIG. 8 or guide plate 143 in FIG. 13) which serves as the zone of first contact for the entering end of card 117 and helps prevent premature wear of bottom roller 106. The line of first contact for the entering end of card 117 is, as shown in FIG. 16, preferably defined the intersection of the X, Y planes. Thus, the combination of translation and torsion of 15 degrees allows card 117 to pass between bottom cleaning roller 106 and first drive roller 118 for pre-printing cleaning.

A person skilled in the art would recognize that other materials and/or configurations may be used to produce card cleaning device 100 provided such other materials and/or configurations do not depart from the intended purpose of the present invention. The card cleaning device of FIGS. 8–19 provides a compact, easy roller access solution to the above-identified problems of the prior art and may be incorporated in a variety of card printers.

In accordance with an alternative embodiment of the present invention and as illustrated in FIGS. 20–26, a card cleaning device for use in card printers, generally referred to by reference numeral 200, comprises a plastic frame 202 (FIG. 21) having a lower portion 201 adapted to operatively accommodate a bottom card cleaning roller 206 and an upper portion 221 adapted to operatively accommodate a top adhesive roller 204 on top of card cleaning roller 206 with top adhesive roller 204 being in frictional contact with bottom cleaning roller 206. Card cleaning device 200 also includes a plastic lid 208 pivotally hinged on each side to upper portion 221 of frame 202 to allow easy access to top adhesive roller 204 for maintenance and/or replacement as illustrated in FIG. 22.

Plastic lid 208 includes a pair of oppositely spaced preferably L-shaped arms 255 (FIG. 25) and 257 (FIG. 20) each pivoted at one end to upper portion 221 of frame 202 by a pair of pins 250 (FIG. 25) and 252 (FIG. 20) mounted in aperture 251 (FIG. 25) and aperture 253 (FIG. 20) provided on upper portion 221 of frame 202, respectively. Lid 208 can be manually flipped on one side by the user to facilitate roller maintenance (FIG. 22). A pivot axis 254 is defined through the center of each pin (250, 252) as illustrated in FIG. 24*a* with the range of angular motion of lid 208 about pivot axis 254 in one example of about 0°–180° with 0° corresponding to a fully closed position of lid 208 as shown in FIGS. 20, 23*a*, 25*a* and 26, and 180° corresponding to a fully open position of lid 208 (not shown). Other lid ranges of motion may be utilized provided such other ranges do not depart from the scope of the present invention. Lid 208 is also provided in the front with a pair of integral hooks 258, 256 on each side as depicted, for example, in FIGS. 20, 21.

Bottom card cleaning roller 206 is essentially identical in construction to lower cleaning roller 16 of FIG. 2 and includes a solid annular silicon rubber body 207 (FIG. 21) with a slightly sticky outer surface area for picking up dust particles from a passing card and a solid generally cylindrical shaft 210 disposed inside annular body 207 and projecting on each side (away from body 207) as shown in FIG. 21. Bottom card cleaning roller 206 performs essentially the same function as lower cleaning roller 16 of FIG. 2 during printer operation. Cylindrical shaft 210 mounts at each end for rotation in a generally L-shaped aperture 212 (FIGS. 20, 21) and aperture 214 (FIG. 23*a*) provided on each side of frame 202 (FIG. 21). Apertures 212, 214 are designed to allow some vertical movement of mounted shaft 210 to accommodate the card thickness but almost no horizontal movement of mounted shaft 210 during printer operation. Each aperture is also adapted to allow easy removal of bottom roller 206 for maintenance as generally illustrated in FIG. 21. Specifically, each aperture has an elongated generally vertical bottom portion, such as bottom portion 211 of aperture 212 (FIG. 21) for accommodating each end of mounted shaft 210 during operation and an elongated generally outwardly curved (away from lower portion 201 of frame 202) horizontal top portion, such as top portion 213 of aperture 212 (FIG. 21) which provides the extra space needed by the user to allow disengagement of each mounted end of shaft 210 from frame 202 if bottom roller 206 needs maintenance or replacement. Before bottom roller 206 can be disengaged from frame 202, top adhesive roller 204 is removed from frame 202 as shown in FIG. 22.

As depicted in FIG. 21, top adhesive roller 204, which has essentially identical construction and function as upper

cleaning roller **14** of FIG. **3**, comprises generally a tubular body **222** with a removable inner inner two-piece ribbed core **224** of the same type and construction as core **124** of FIG. **10**. Core **224** terminates on each side with a generally circular end cap such as end caps **226, 228**. Each end cap includes a nob (such as nobs **230, 232**) which has a narrow elongated neck (e.g., nob neck **234**) supported on four generally triangular shaped racks **236, 238, 240, 242** as illustrated in FIG. **21**. Each nob neck (e.g., nob neck **134**) mounts for rotation in a corresponding generally V-shaped slot (flared portion of slot facing away from upper portion **221** of frame **202**), such as slot **235** or slot **237**, provided at one end of frame **202** as shown in FIG. **21** with each nob disposed outside of each slot (FIGS. **20, 23**). Slots **235, 237** are designed to allow some vertical movement but almost no horizontal movement of the nob necks once top adhesive roller **204** is mounted for operation directly on top of bottom card cleaning roller **206** as shown in FIG. **26**.

The outer surface of tubular body **222** is preferably pre-wrapped with an adhesive strip layer **203** (FIG. **20**) which is essentially identical to the one used in the embodiment of FIGS. **1–7** and is generally stickier than the outer surface of bottom roller **206**. Several overlapping layers of adhesive strips (not shown) may also be used if desired. Furthermore, adhesive top roller **204** preferably has a diameter greater than the diameter of bottom card cleaning roller **206** so as to provide a substantially larger effective cleaning surface area for top adhesive roller **204** compared to bottom cleaning card roller **206**. The larger effective cleaning surface area allows top adhesive roller **204** to pick up and retain more dust particles than bottom roller **206** which is a significant advantage over prior art card cleaning schemes as bottom roller **206** need not be changed as often as needed in conventional card printers.

Maintenance of top adhesive roller **204** is relatively easy as roller **204** may either be replaced with a new adhesive roller or, if equipped with multiple surface adhesive layers, the user would simply peel off the top-most used adhesive layer to expose a clean adhesive layer underneath. To perform maintenance on top adhesive roller **204**, the user flips lid **208** on one side with one hand as shown by directional arrow **262** in FIG. **22** and pulls roller **204** out with the other hand via the outwardly flared portion of each V-shaped slot as shown by directional arrow **264** in FIG. **22**. To prevent the nob neck (of top adhesive roller **204**) on each side from freely moving in the vertical direction inside slot **212** (or **214**) during printing operation, a pair of coiled springs **242, 244** (FIG. **21**) are mounted between hooks **258, 256** and a pair of integral cylindrical outwardly projecting posts **231, 233** provided on each side of the outer wall of upper portion **221** of plastic frame **202** as shown in FIG. **20**. For example, one end of spring **242** may be wound on cylindrical post **231** with the other end of spring **242** wound on hook **258** as generally shown in FIG. **20**.

To maintain pressure on each of the nob necks of top adhesive roller **204** during printer operation, lid **208** is preferably provided internally on each side proximate to each of the L-shaped arm s with an integral generally cube-shaped projection, such as projection **260** (FIG. **21**) and is spring loaded as described above via coiled springs **242, 244** (FIGS. **8, 10**). When lid **208** is in a fully closed position during device operation coiled springs **242, 244** exert the necessary amount of pressure on the nob necks of top adhesive roller **204** through the body of lid **208** to assure proper operation of top adhesive roller **204**. Spring loading of lid **208** maintains (by way of top adhesive roller **204**) bottom roller **206** in sufficient frictional contact with the top surface of a card being fed for pre-printing cleaning from a feeder to allow passage of a card such as card **216** between a rotating first driver roller **218** and cleaning roller **206** (which rotates by friction) when lid **208** is in a fully closed position during device operation as depicted, for example, in FIG. **26**. First drive roller **218** is driven by a motor (not shown) which is mounted in the body of the printer (not shown). Shaft **220** of first driver roller **218** is preferably disposed directly under shaft **210** of bottom card cleaning roller **206** as depicted in FIG. **26** in accordance with the general principles of the present invention to ensure proper operation of card cleaning device **200**. Rotating shaft **220** indirectly drives (rotates) bottom cleaning roller **206** which frictionally drives (rotates) top adhesive roller **204** under fully closed lid **208** during device operation enabling continuous cleaning of bottom cleaning roller **206** by top adhesive roller **204**. Lower portion **201** of frame **202** is preferably provided at each end with a concave circular notch, such as notches **205, 209** (FIG. **21**), which is designed to fit around each end of rotating driver roller shaft **220** (not shown)

Card cleaning device **200** is preferably removably installed in a molded section (not shown) of an appropriately configured card printer. Card cleaning device **200** fits into the card path by positioning itself directly on drive roller **218** via notch **205**. The installed card cleaning device **200** may be easily removed by gently pulling up on the device to remove it from the molded section of the printer

In accordance with one aspect of the present invention, the front side **241** (FIG. **20**) or back side **243** (FIG. **23***a*) of card cleaning device **200** may be used for card feeding which is an advantage over prior art cleaning cartridges which need to be inserted in a printer only on one side. Card feeding is accomplished via one of two generally rectangular-shaped card feeding openings provided on opposite sides of lower portion **201** of card cleaning device **200**, e.g., front feeding opening **284** (FIG. **20**) or back feeding opening **286** (FIG. **23***a*) whereby each one of the feeding openings may be used for card feeding depending on the particular orientation of the installed card cleaning device **200**.

For example, if back feeding opening **286** is used for feeding as shown in FIGS. **23***a*, **24***a*, the card (e.g., card **217**) would enter back feeding opening **286** at an angle (FIG. **23***b*) as shown by directional arrow **267** in FIG. **23***a*, bend slightly at its entering end (FIG. **24***b*) as shown by directional arrow **269** in FIG. **24***a*, then pass horizontally for (pre-printing) cleaning between first driver roller **218** and bottom cleaning roller **206**, exit card cleaning device **200** via front opening **284** for printing, return to (i.e., re-enter) card cleaning device **200** after printing via front feeding opening **284** and exit card cleaning device **200** (FIG. **25***b*) again (on the same side it originally entered) via back feeding opening **286** as shown by directional arrow **270** in FIG. **25***a* on its way out to a card output hopper (not shown).

Each card is preferably fed from a card feeder **290** (FIG. **23***b*) at an angle to save internal printer space allowing for the manufacture of a more compact printer which is an advantage over conventional bulky card printers. Card feeder **290** is preferably disposed over the card exit path defined by a horizontal plane X passing centrally between bottom cleaning roller **206** and first driver roller **218** (FIG. **23***b*) as near as possible to card cleaning device **200**. In one example, the distance between roller **218** and roller **294** is ¾ of an ISO card (ISO card dimension –87.72±0.25 mm). The preferred angle of entry is approximately 15° which is measured between horizontal plane X and a card entry path